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Review Article

Use of a nasogastric tube guidewire to assist awake fiberoptic bronchoscope guided intubation in two patients with severe glottic or subglottic stenosis in an emergency: report of two cases and review of the literature

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Abstract: This article presents two case reports about use of nasogastric tube guidewire to facilitate awake endotracheal intubation guided by fiberoptic bronchoscopy in emergency situations. It also includes a review associated with usage of introducers or catheters to facilitate endotracheal intubation guided by a fiberoptic bronchoscope as alternative intubation techniques in difficult airway management. This fiberoptic bronchoscope/nasogastric tube guidewire technique is recommended as an alternative where other tools are unavailable. The optimal choice for airway management depends on the availability of the equipment and the experience of the practitioner.

Keywords: Awake intubation, intubation techniques, anticipated difficult airway, difficult airway management, fiberoptic bronchoscope, nasogastric tube

Introduction

Difficult airway management is a great challenge to an anesthesiologist. Severe airway stenosis tends to lead serious complications during sedation, anesthetic induction, and intubation [1-8]. Awake fiberoptic bronchoscope (FOB) guided intubation is a standard method in the difficult airway algorithm [1-8], but the FOB is too thick to pass through the stenosis itself in some cases, so a thin guidewire is necessary to pass through the working channel of FOB to advance through the narrow part, and then guide the passage of endotracheal tube into the trachea. A nasogastric tube (NGT) guidewire was chosen to be the guidewire in emergency situations when other tools were not available, because it was thin, smooth, semirigid, blunt tipped, available, sterile, and cheap. Herein is described the clinical use of this technique in the management of two patients who present with severe dyspnea, a predicted difficult intubation and pre-existing glottic or subglottic stenosis. A review of FOB-guided intubation with the assistance of introducers or catheters is also included.

Report of cases

Case 1

A 67-year-old woman (61 kg, 163 cm) was admitted for tracheotomy and large cervical mass resection. The patient was in compulsive Fowler's position because of progressive severe dyspnea. She had obvious three depressions sign during inspiratory phase. Examination of the patient's airway revealed she had Mallampati 4 and normal mouth opening with intact dentition. Large cervical mass was noted in the submandibular area and anterior neck and her neck extension was slightly limited (**Figure 1**). Cervical computerized tomography revealed narrowing of glottic chink and large cervical mass infiltrating into the bilateral vocal cords (**Figure 2**). According to the above findings and

Figure 1. Photograph of the case demonstrating large cervical mass.

computerized tomography result, the patient was assessed to have had a high risk of inadequate mask ventilation under anesthesia and predicted difficult intubation under direct laryngoscopy. Awake FOB-guided intubation was planned. The patient was informed about the procedure.

She was monitored with electrocardiogram, oxygen saturation, and noninvasive blood pressure in the operating room. The patient was placed in Fowler's position because of severe dyspnea. Midazolam 0.03 mg/kg and fentanyl 1 mcg/kg was intravenously administrated. The airway was anesthetized with aerosolized 2% dicaine.

The FOB (A41, Zhuhai maidehao medical technology CO., LTD, Zhuhai, Guangdong, China) which has an outer diameter of 5.2 mm was inserted nasally. On visualizing the glottic chink, both vocal cords were found to be significantly thickened and stiff. The glottic chink was too narrow for the FOB to pass through. After several failure attempts, a nasogastric tube (NGT) guidewire (head was removed) to pass through the working channel of the FOB (**Figure 3**) to be advanced through the narrow glottic chink to get into the trachea, and then we retrieve the FOB and left the NGT guidewire in place to railroad a small sized endotracheal tube (5.5 mm ID) into the trachea. Capnograph was attached to confirm successful endotracheal intubation after securing the airway. Surgeons excised the cervical mass and performed tracheotomy. The patient had an uneventful recovery.

Case 2

A 73-year-old woman (1.55 m, 45 kg) with progressive dyspnea was admitted for a suspension laryngoscopy and subglottic tumor resection. The patient had Mallampati 2, normal mouth opening with loose incisors, and a thyromental distance of 6 cm under airway examination. Her neck extension wasn't limited. She had obvious three depressions sign during inspiratory phase. Laryngoscopy showed that a subglottic tumor was seen obstructing almost all of the tracheal lumen (**Figure 4**). However, in light of the above findings and laryngoscopy results, there was a high risk of difficult intubation and inadequate mask ventilation under anesthesia. Oropharyngeal anesthesia was achieved with 2% aerosolized dicaine. After the patient was placed in supine position and monitored, awake oral FOB-guided intubation was performed using a NGT guidewire inserted through the working channel of FOB. On visualizing the glottic chink and the tumor (**Figure 5**), the NGT guidewire was passed along the side of tumor into the trachea, simultaneously visualizing its pedicle to avoid any injury and bleeding. After retrieval of the FOB and leaving the NGT guidewire in the trachea, the FOB was nasally inserted to establish a view of the vocal cords and tumor, and then a 5.5-mm reinforced endotracheal tube (Henan jianqi Medical Equipment CO., LTD, Changyuan, China) was advanced gently over the NGT guidewire into the trachea under direct visualization with the FOB. Capnograph was attached to confirm successful endotracheal intubation after securing the airway. The case proceeded uneventfully. Surgeons excised the tumor and hemostasis was achieved. The patient was extubated at the recovery room and recovered well without stridor, dysphonia, or other airway-related side effects on postoperative day 1.

Written consent of publishing of this paper was obtained from these two patients and their significant others.

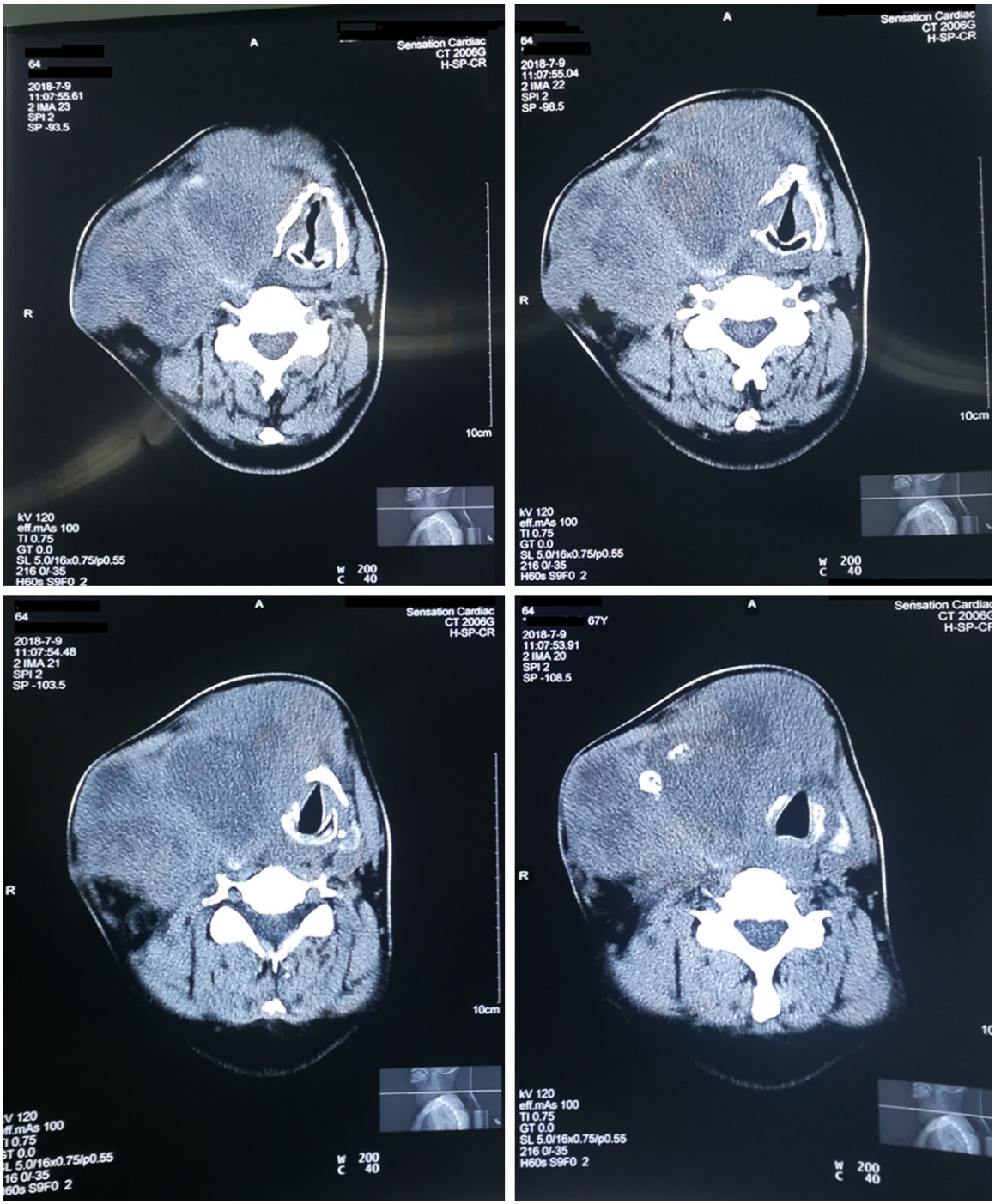

Figure 2. Computed tomography scan of the neck reveals narrowing of glottic chink and large cervical mass infiltrating into the bilateral vocal cords.

Discussion

The American Society of Anesthesiology (ASA) updated the guidelines of difficult airway management. Awake endotracheal intubation is at the top of the decision making tree of the ASA difficult airway algorithm on the base of a patient's history of difficult endotracheal intubation and/or mask ventilation, or in patients whose physical characteristics suggest such difficulties [9]. Although FOB is commonly used [10, 11], other tools may be needed and available to achieve awake endotracheal intubation [12].

Figure 3. Insertion of nasogastric tube guidewire. A nasogastric tube guidewire (head was removed) passes through the working channel of the fiberoptic bronchoscope.

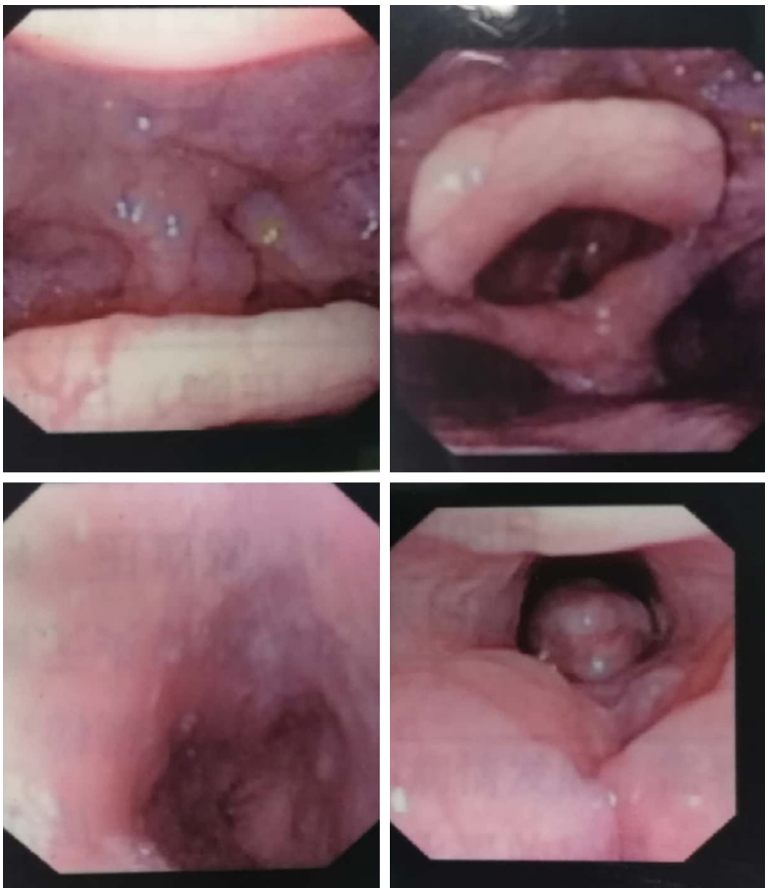

Figure 4. Laryngoscopy shows that a subglottic tumor is seen obstructing almost all of the tracheal lumen.

The fiberoptic bronchoscope is 5.2 mm in diameter and too thick to pass through the narrow airway itself in this paper, so a thin guidewire is necessary to get through the stenosis part to enter the tracheal. In these two cases of narrow airway management, the NGT guidewire serves as an intubation guidewire for awake FOB-guided intubation. The optimal choice for airway management depends on the availability of the equipment and the experience of the practitioner. The situation is an emergency where other tools are unavailable and NGT guidewire is easily available in the operating room.

We choose NGT guidewire to be the intubation guidewire, because it is thin, smooth, stiff, blunt tip, sterile, cheap and easily advances through the FOB working channel. Trauma to the airway is less likely in this technique due to the blunt tip and smooth feature of the catheter. If fluoroscopy is available, we can check the guidewire position. A soft tip and long angiography guidewire is an alternative. It has been reported that a 3 mm ID endotracheal tube can be inserted over the angiography guidewire (Terumo 0.035") into the trachea through a laryngeal mask airway [13].

A number of techniques using introducers or catheters can facilitate insertion of an endotracheal tube, guided by a FOB. Therefore, a review of the use of the following devices cover the following areas: 1) a guidewire/exchange catheter, 2) an Aintree Intubation Catheter, 3) a gum elastic bougie.

The guidewire/exchange catheter

This technique involves a wire-guided approach with or without an airway exchange catheter. This technique involves insertion of a FOB in the patient's oropharynx to establish a view of the vocal cords, followed by insertion of a guidewire through the FOB into the trachea. The FOB is removed and an exchange catheter is railroaded over the guidewire. An endotracheal tube is railroaded over the exchange catheter into the trachea [14]. The guidewire-catheter technique

Figure 5. Fiberoptic view of the trachea. A subglottic tumor is seen obstructing almost all of the tracheal lumen.

for tracheal intubation has been shown to work [9, 15-17].

In the case of the guidewire, the clinician may choose to railroad an endotracheal tube directly over the guidewire. Commonly used guidewires are 145-170 cm in length and 0.035-0.038 inches (approximately 1 mm) in diameter. Therefore, these guidewires will fit into the working channel of even a small-sized FOB or within an exchange catheter. The NGT guidewire used in this paper is 127 cm in length (head is removed) and 1 mm in diameter, which is similar with the guidewires. However, because of the small diameter and relative softness of the guidewire, railroading an endotracheal tube may displace the guidewire and lead to esophageal intubation and the large size discrepancy between the small diameter wire and the much larger diameter endotracheal tube may result in endotracheal tube impingement at the arytenoid level [18, 19].

Based on the results of this study, it is recommended that a two-stage endotracheal tube insertion be performed. First, an exchange catheter (11, 14, or 19 Fr) would be loaded onto the guidewire to increase the diameter and stiffness of the introducer, and second, an endotracheal tube would then be railroaded over the exchange catheter into the trachea. It is a pity that exchange catheters are not available in our department.

S. S. Dhara describes a new system of guidewire-assisted endotracheal intubation. A reinforced silicone endotracheal tube is modified with a guide channel built inside its wall, and a nitinol non-kinking guidewire is matched to this channel. They suggest that the combination of the modified endotracheal tube and matching guidewire may achieve easy and reliable single-step guided endotracheal intubation [17].

In a number of case reports, the tracheas of patients are intubated successfully using a FOB with the guidewire/exchange catheter technique through supraglottic airway devices [20-25]. Supraglottic airway devices work as a conduit for FOB. It involves a large number of steps, and anesthesiologists must become familiar with the entire sequence to perform the technique well.

Aintree intubation catheter (AIC)

The second technique involves FOB/AIC intubation approach [26]. AIC (Cook Critical Care, Bloomington, IN, USA) is a semi-rigid hollow catheter that can facilitate endotracheal intu-

bation guided by FOB. The device is 57 cm long with an inner diameter of 4.7 mm, allowing the passage of a 4.5-mm FOB through its lumen and leaves the distal 3-10 cm of the FOB unsheathed for manipulation [27]. The AIC has an outer diameter of 6.3 mm, allowing endotracheal tube of size 6.5 mm or greater to be inserted [28]. During endotracheal intubation, the AIC is mounted over a FOB, and the FOB/AIC assembly is inserted into the trachea. After the FOB is withdrawn, an endotracheal tube is railroaded over the AIC into the trachea. During this process, the AIC can also be used for interim ventilation through the use of a detachable Rapi-fit connector (Cook Critical Care, Bloomington, IN, USA) [29, 30].

The endotracheal tube is allowed by AIC to be inserted is at least 6.5 mm, which is too great to pass through the stenosis airway in these two cases. Besides, AIC is not available in our hospital. Furthermore, the study above found that only 50% of anesthetic departments in the UK had AICs available for use [29]. It has been reported that eighty-four percent of anesthesiologists who participant the study prefer railroading the endotracheal tube directly over the FOB rather than over an AIC [29]. However, the multiple steps involved with the use of the FOB/AIC may deter some anesthesiologists from incorporating this technique into practice.

Therefore, when choosing to place an AIC over the bronchoscope, the clinician is limited by the ID of the AIC relative to the external diameter of the bronchoscope. The use of an AIC may have some advantages: 1) the position of the AIC is confirmed under direct vision; 2) the potential for dislodgement of the endotracheal tube during removal of the FOB is minimized; and 3) the rigidity of the AIC minimizes the potential for inadvertent malpositioning of the distal tip of the smaller diameter FOB when the endotracheal tube is advanced. Malpositioning may lead to esophageal intubation, a common problem seen with use of guidewires and a smaller diameter FOB.

FOB-guided insertions of a bougie and Frova® intubation introducer

The third technique in which endotracheal intubation can be achieved through the use of FOB is with the bougie. Bougies are solid introducers 60-70 cm long with a 35-40° distally angulated (Coude) tip. They are easy to use, widely available, inexpensive, and have been used as adjuncts to difficult direct laryngoscopy for many decades [31]. The bougie and FOB are inserted in parallel through a supraglottic airway device and advanced in tandem. One operator steers the FOB while the second operator steers the bougie under FOB guidance into the trachea. Insertion of a FOB in conjunction with a bougie through a supraglottic airway device can potentially increase the intubation success rate [32, 33]. After the FOB and supraglottic airway device are removed, an endotracheal tube can subsequently be railroaded over the bougie into the trachea. The Frova® Intubation introducer is a similar device which comes in various lengths (35 or 65 cm) and diameters (1.6 or 3.0 ID). Unlike the bougie, it contains a lumen designed to allow oxygenation. FOB-guided insertions of a bougie and Frova® intubation introducer through a laryngeal mask airway have been described.

A bougie and Frova® intubation introducer are not flexible or thin enough to pass the stenosis airway of these two cases. In addition, case 2 is associated with poor supraglottic airway device placement because of anatomical distortion of the oropharynx due to the tumor infiltration.

In summary, endotracheal intubation guided by FOB can be performed with use of a NGT guidewire. However, some modifications of equipment are required to overcome some of the limitations associated with use of FOB for endotracheal intubations, especially in emergency situations.

There isn't sufficient evidence to recommend one technique over the others. The AIC coupled with a FOB can be inserted under guidance into the trachea by one operator in a single step. In contrast, the guidewire/exchange catheter technique involves more steps. The parallel bougie/FOB insertion necessitated a coordinated effort of two operators. Usage of introducers or catheters through a FOB to facilitate intubation may be a useful alternative intubation technique in difficult airway management.

Disclosure of conflict of interest

None.

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